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Forest Sciences

Prince Rupert Forest Region

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Genetics and Seedling Biology of Sitka Spruce Hybrids

Research Issue Groups:

- Forest Biology
- Forest Growth
- Soils
- Wildlife Habitat
- Silviculture
- Ecosystem Inventory and Classification
- Biodiversity
- Ecosystem Management
- Hydrology
- Geomorphology
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Introduction

In west central British Columbia, Sitka spruce grows along the coast, and interior spruce (a hybrid of white spruce and Engelmann spruce) grows in the interior regions - primarily east and north of the Bulkley River. Between these areas is the Nass Skeena transition zone which is populated by hybrids of interior spruce and Sitka spruce. These transition trees are called "hybrid Sitka spruce."

There is currently intensive harvesting and reforestation of the Sitka spruce hybrids in this area. This has resulted in the need for more accurate information about replacement seedlings and their suitability to growing sites. In addition, some foresters would like to try to increase productivity in these areas by introducing trees with better growth and survival characteristics.

Recent research using DNA techniques to determine the geographic distribution of the Sitka spruce hybrids and to correlate several growth and survival characteristics with genetic makeup will make these tasks easier.

Geographic Distribution

In research conducted by B.C. Research, Inc. and funded by the B.C. Ministry of Forests, plants from seven seed lots in the Bulkley Valley and samples from 12 sites in the Nass Skeena transition zone were subjected to DNA analysis. The results of this analysis are expressed as 'interior spruce fraction', and are shown on the map on the back page.

The circles are labelled B (for Bulkley Valley) and N (for Nass Skeena). The amount of black represents the interior spruce fraction as determined by DNA analysis. Thus, the solid black B7 is 100% interior spruce, N2 is 46% interior spruce, and N11 is almost pure Sitka spruce, having an interior spruce fraction of only 0.01.

Genetics and Environment

Foresters have long known that Sitka spruce grows faster but is less tolerant of freezing and drought than

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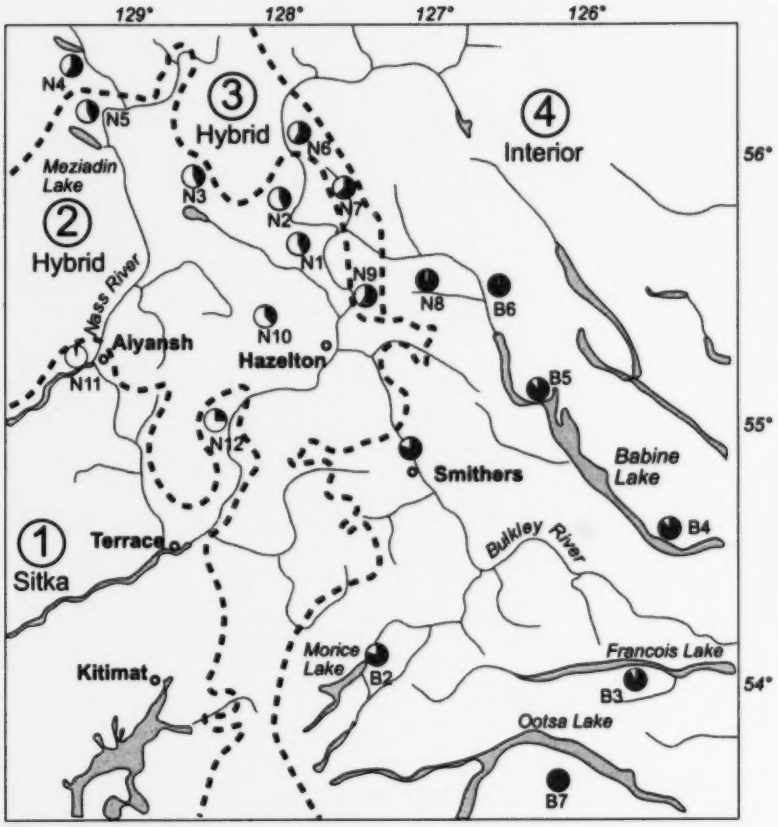

Figure 1. Area of west-central B.C. where hybridization between coastal Sitka spruce in the west and interior spruce in the east occurs. Shaded circles are locations of samples from either the Bulkley Valley (B) or Nass Skeena regions (N). See text for further explanation (indicates fraction interior spruce relative to location).

interior spruce. However, until now there has been no way to relate the amounts of Sitka spruce and interior spruce genetic material in a hybrid to the rate of growth or degree of freezing and drought tolerance.

This has now been done by taking the plants used in the DNA analysis shown on the map and growing seedlings. These seedlings were subjected to a number of growth, freezing tolerance and drought tolerance tests. Thus, there are now data relating these biological functions to genetic makeup.

The research has confirmed previous observations relating to the rapid growth of Sitka spruce and the freezing and drought tolerance of interior spruce, and has shown that intermediate amounts of these traits are related to intermediate amounts of genetic material.

In addition, several other relationships between genetic makeup and growth characteristics have been determined. Among them are the following:

- bud break depends on both genetic (interior spruce fraction) and environmental (low temperatures of the previous winter) factors;
- increase of freezing tolerance in the fall, but not loss of freezing tolerance during the growing season, depends on interior spruce fraction; and,
- Sitka spruce seedlings can reach a point where they experience drought stress even when there is adequate soil moisture.

Discussion

Using DNA markers for genetic makeup of both seeds and trees in planting sites, it will be possible to make distribution decisions in cases where current seed transfer guidelines are somewhat in doubt.

Much of the information gained about the relation of interior spruce fraction to growth, freezing tolerance and drought tolerance can be used to refine growing techniques in ways that will result in improved containerized stock and outplanting.

Information that relates genetic makeup to growth and survival characteristics can be used to select higher production hybrids with more confidence.

The text for this Extension Note was prepared by Holcomb Communications, Brentwood Bay, B.C.

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References for Further Reading

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